

**UNIVERSALLY POSITIONABLE MOUNTING
DEVICE****RELATED APPLICATIONS**

This Application is a Continuation of application Ser. No. 08/689,408, now abandoned, filed Aug. 7, 1996 and entitled **UNIVERSALLY POSITIONABLE MOUNTING ARM**. application Ser. No. 08/689,408 was in turn a Continuation of application Ser. No. 08/574,415, now abandoned filed Dec. 15, 1995, and having the same title. Application Ser. No. 08/574,415 was in turn a Continuation of application Ser. No. 08/375,568, now abandoned, filed Jan. 13, 1995 and having the same title. And application Ser. No. 08/375,568 was in turn a Continuation of application Ser. No. 08/167,500, now abandoned, filed Dec. 14, 1993 and having the same title.

TECHNICAL FIELD

My invention relates to a mounting device for interposing along a line of juncture between a pair of relatively movable and relatively stationary objects, to support the relatively movable object on the relatively stationary object at a selected angular orientation of the line of juncture with respect to one of the objects. It relates in particular to a device of this nature which is universally positionable between the pair of objects, to support the relatively movable object on the relatively stationary object at variable angular orientations of the line of juncture with respect to either or both of the objects.

THE INVENTION IN GENERAL

In one combination thereof, my mounting device comprises means for forming a first coupling member on a first of the objects and a base on a second of the objects at spaced first and second loci, respectively, adjacent opposite ends of the line of juncture; and a split-arm assembly comprising a pair of elongated relatively rigid arm sections which are operatively juxtaposed to one another along the line of juncture between the spaced first and second loci of the first coupling member and the base, and have pairs of corresponding first and second end portions thereof that are operatively opposed to one another across a plane coincident with the line of juncture. The first coupling member has a body with part spherical surfaces at the outer periphery thereof that are disposed on opposite sides of the plane of the line of juncture to substantially coincide with a first circle of revolution having its center at the first locus of the first coupling member, and also having pressure deformable material therein so that the body of the first coupling member can be squeezed between the surfaces thereof to less than the diameter of the first circle of revolution. Means form a pair of operatively opposing first sockets in the pair of first end portions of the respective arm sections, and the device further comprises means for applying initial clamping forces to the pair of arm sections to squeeze the pair of arm sections together relatively crosswise the plane of the line of juncture, and means for producing a differential in the reaction of the respective pairs of first and second end portions of the arm sections to the initial clamping forces so that when squeezed together, the pair of arm sections assumes a relatively transversely contracted disposition thereof about the first coupling member and the base in which the pair of first sockets in the pair of first end portions of the pair of arm sections is operatively engaged about the outer peripheral surfaces of the first coupling member in substantial coincidence with the first circle of revolution, but

the pair of second end portions of the pair of arm sections is spaced apart from one another about the base to the extent that although the pair of arm sections forms a connection between the first coupling member and the base, the connection allows the pair of arm sections to be squeezed further together about the base. When the pair of arm sections assumes the relatively transversely contracted disposition thereof about the first coupling member and the base, the pair of first sockets is adapted to form a first ball and socket joint with the outer peripheral surfaces of the first coupling member so that the first coupling member and the pair of arm sections can be pivoted in relation to one another at the first joint to position the line of juncture at a selected angular orientation with respect to the aforementioned one object. Moreover, when the pair of arm sections is in the relatively transversely contracted disposition thereof about the first coupling member and the base, the device further comprises means for applying additional clamping forces to the pair of arm sections to squeeze the pair of arm sections further together relatively crosswise the plane of the line of juncture, and means for producing a differential in the reaction of the respective pairs of first and second end portions of the pair of arm sections to the additional clamping forces so that when squeezed further together in the relatively transversely contracted disposition thereof, the pair of arm sections pivot in relation to one another about the first coupling member to reduce the space between the second end portions of the respective arm sections about the base while the pair of first sockets engages the outer peripheral surfaces of the body of the first coupling member to squeeze the body therebetween and interlock the pair of arm sections with the first coupling member to rigidify the connection between the first coupling member and the base at the selected angular orientation of the line of juncture with respect to the one object. That is to say, when the pair of arm sections is in the relatively transversely contracted disposition thereof, the device forms a ball and socket joint with the first coupling member whereby the line of juncture can be positioned at any angular orientation one chooses, and then when additional clamping forces are applied, that same first coupling member which was a part of the ball and socket joint, is given a new and additional function of aiding in the rigidifying of the connection formed by the pair of arm sections between the first coupling member and the base. Furthermore, in certain presently preferred embodiments of the invention wherein the pressure deformable material is resilient, the means for applying additional clamping forces to the pair of arm sections are releasable relatively crosswise the plane of the line of juncture to restore the first joint so that the pair of arm sections and the first coupling member can be pivoted in relation to one another to position the line of juncture at a different angular orientation with respect to the one object. That is to say, the same coupling member which was a part of the ball and socket joint, and then contributed to the rigidification of the connection between the coupling member and the base, can be restored to its initial function of participating once more in the ball and socket joint. And meanwhile, throughout it all, the assembly will remain fully intact; that is, there will be a sustainable connection throughout between the first coupling member and the base.

In many of the presently preferred embodiments of the foregoing combination, the base has attachment means thereon for forming the connection between the first coupling member and the base, and the arm sections are operatively juxtaposed about the plane of the line of juncture so that when the pair of arm sections is squeezed together by

the initial clamping forces to assume the relatively transversely contracted disposition thereof, the second end portions of the pair of arm sections are reciprocated in relation to one another about the base to first positions thereof in which the pair of second end portions is mutually opposed 5 to one another across the plane and the attachment means form a connection between the first coupling member and the base, but the pair of second end portions is sufficiently spaced apart from one another in the connection that the connection allows the pair of arm sections to be squeezed 10 further together about the base. In some of these embodiments, the attachment means are operatively interposed between the pair of second end portions in the connection, but adapted so that the respective second end portions of the arm sections are spaced apart from the 15 attachment means when the second end portions assume the first positions thereof in the relative reciprocation thereof, and the device further comprises means operatively interposed between the attachment means and the respective second end portions to loosely interconnect the attachment 20 means with the pair of second end portions and vice versa when the second end portions assume the first positions thereof in the relative reciprocation thereof. In one group of embodiments, the attachment means include a second coupling member having a body with part spherical surfaces at 25 the outer periphery thereof that are disposed on opposite sides of the plane of the line of juncture to substantially coincide with a second circle of revolution having its center at a point between the first positions of the second end portions of the arm sections in the relative reciprocation 30 thereof, and the device further comprises means forming a pair of operatively opposing second sockets in the pair of second end portions of the respective arm sections, which engage about the outer peripheral surfaces of the second coupling member in a third circle of revolution concentric 35 with the second circle of revolution but having a greater diameter than the second circle of revolution so that when the second end portions of the arm sections assume the first positions thereof in the relative reciprocation thereof, the body of the second coupling member and the respective 40 second end portions of the arm sections are loosely interconnected with one another but spaced apart from one another by the differential between the diameters of the second and third circles of revolution. In certain of the 45 group, the body of the second coupling member has pressure deformable material therein so that the body of the second coupling member can be squeezed between the surfaces thereof to less than the diameter of the second circle of revolution, and the arm sections are operatively juxtaposed 50 about the plane of the line of juncture so that when the pair of arm sections is squeezed further together by the additional clamping forces, the second end portions of the pair of arm sections are reciprocated in relation to one another about the base to second positions thereof mutually opposed to one 55 another across the plane of the line of juncture and in which the pair of second sockets forms a second ball and socket joint with the outer peripheral surfaces of the second coupling member, so that the second coupling member and the pair of arm sections can be pivoted in relation to one another at the second joint to also position the line of juncture at a 60 selected angular orientation with respect to the other object if desired, and then to third positions thereof mutually opposed to one another across the plane of the line of juncture in which the pair of second sockets engages the outer peripheral surfaces of the body of the second coupling 65 member to squeeze the body therebetween and interlock the pair of arm sections with the second coupling member to

rigidify the connection between the respective first and second coupling members at the selected angular orientation of the line of juncture with respect to each of the objects.

Furthermore, in some embodiments, the pressure deformable material in the bodies of the respective first and second coupling members is resilient and the means for applying additional clamping forces to the pair of arm sections are releasable relatively crosswise the plane of the line of juncture to restore the first and second joints so that the pair of arm sections can be pivoted in relation to the respective first and second coupling members and vice versa, to position the line of juncture at different angular orientations with respect to the one and/or the other objects. In one special group, the differential producing means include yieldable biasing means, and the space between the first and second loci of the first coupling member and the base, respectively, is of such length that when the second coupling member is detached from the split-arm assembly and vice versa, the pair of arm sections can be pinched together against the bias of the biasing means to separate the pair of first sockets from one another to the extent that the first coupling member can be detached from the pair of arm sections and vice versa.

In one particularly advantageous version of my device, the means for producing a differential in the reaction of the respective pairs of first and second end portions of the arm sections to the initial clamping forces include means operable to generate a lopsided effect in the application of the initial clamping forces to the respective pairs of first and second end portions of the arm sections when the pair of arm sections is squeezed together to assume the relatively transversely contracted disposition thereof. And in a related version, the base has attachment means thereon for forming the connection between the first coupling member and the base, and the attachment means and the first coupling member have means operatively interposed therebetween to generate a lopsided effect in the application of the initial clamping forces to the respective pairs of first and second end portions of the arm sections when the pair of arm sections is squeezed together to assume the relatively transversely contracted disposition thereof. In certain embodiments of this latter version, the attachment means include a second coupling member having a body with part spherical surfaces at the outer periphery thereof that are disposed on opposite sides of the plane of the line of juncture to substantially coincide with a second circle of revolution having its center at a point interposed between the second end portions of the arm sections when the pair of arm sections is squeezed together to assume the relatively transversely contracted disposition thereof. Moreover, in these embodiments of the latter version, the first and second circles of revolution have substantially equal diameters, and the means for generating a lopsided effect in the application of the initial clamping forces to the respective first and second end portions of the arm sections include yieldable biasing means disposed to oppose the application of the initial clamping forces to the second end portions of the respective arm sections. In some embodiments of this latter version, the yieldable biasing means are interposed across the plane of the line of juncture between the first and second coupling members. And in certain of them, the initial clamping forces are applied to the pair of arm sections along a line interposed across the plane of the line of juncture between the yieldable biasing means and the first coupling member. In many of them, moreover, the yieldable biasing means take the form of a coiled spring which is caged between the pair of arm sections along a line interposed across the plane of the line of juncture substantially parallel to the line of application of the initial clamping forces.

In this latter version, the arm sections may be operatively juxtaposed about the plane of the line of juncture so that when the pair of arm sections is squeezed together by the initial clamping forces, the second end portions of the pair of arm sections are reciprocated against the bias of the yieldable biasing means to positions mutually opposed to one another across the plane and in which the second coupling member forms a connection between the first coupling member and the base, but the pair of second end portions is sufficiently spaced apart from one another in the connection that the connection allows the pair of arm sections to be squeezed further together about the base. Furthermore, the space between the first and second loci of the first coupling member and the base, respectively, may be of such length that when the second coupling member is detached from the split-arm assembly and vice versa, the pair of arm sections can be pinched together against the bias of the biasing means to separate the first end portions of the arm sections from one another to the extent that the first coupling member can be detached from the pair of arm sections and vice versa.

For the purposes of many embodiments, the pressure deformable material renders the body of the first coupling member radially compressible at the outer peripheral surfaces thereof. And for many embodiments, the first sockets have surfaces at the inner peripheries thereof which are adapted to form the first ball and socket joint with the outer peripheral surfaces of the first coupling member when the pair of arm sections assumes the relatively transversely contracted dispositions thereof about the first coupling member and the base.

For many of those embodiments wherein the pressure deformable material renders the body of the first coupling member radially compressible at the outer peripheral surfaces thereof, the inner peripheral surfaces of the first sockets are part spherical and are adapted firstly, to substantially coincide with the first circle of revolution when the pair of arm sections assumes the relatively transversely contracted disposition thereof about the first coupling member and the base, so that the first joint is formed between the respective inner and outer peripheral surfaces of the first sockets and the first coupling member, and then to compress the body of the first coupling member radially thereof at the outer peripheral surfaces thereof when the pair of arm sections is squeezed further together in the relatively transversely contracted disposition thereof to interlock the pair of arm sections with the first coupling member and rigidify the connection between the first coupling member and the base at the selected angular orientation of the line of juncture with respect to the one object.

Sometimes, the respective means for applying the initial clamping forces and the additional clamping forces to the pair of arm sections include a pin and hole fastening device for fastening the pair of arm sections together relatively crosswise the plane of the line of juncture, and a clamping mechanism on the fastening device for applying clamping forces to the pair of arm sections through the fastening device.

The first coupling member may be formed of nitrile rubber material at the surface thereof.

If desired, the pair of arm sections may be adapted to extend rectilinearly between the spaced first and second loci of the first coupling member and the base.

The means forming the first coupling member and the base may be elements physically separate and distinct from the objects themselves but attachable thereto. And the split

arm assembly may be physically separate and distinct from the means for forming each of the first coupling member and the base.

Also, the split arm assembly may be physically separate and distinct from the base.

In another combination thereof, the split arm assembly of the device comprises a pair of relatively rigid arm sections which have pairs of corresponding first and second end portions thereof which are operatively opposed to one another across a plane coincident with the line of juncture, so as to be disposed adjacent the first coupling member and the base, respectively. Clamping means are operable to squeeze the pair of arm sections together relatively crosswise the plane of the line of juncture, and the device further comprises means for producing a differential in the reaction of the respective pairs of first and second end portions of the arm sections to the squeezing action of the clamping means, so that when squeezed together, the pair of arm sections forms a bifurcated arm assembly that in a first position thereof, has its apex at the first locus of the first coupling member and is loosely engaged about the base at the second end portions thereof. Means form a pair of operatively opposing first sockets in the first end portions of the respective arm sections, having substantially smooth part spherical surfaces at the inner peripheries thereof which substantially coincide with a circle of revolution which has its center at the first locus of the first coupling member when the bifurcated arm assembly is engaged in the first position thereof about the first coupling member. Meanwhile, the first coupling member has a substantially smooth part spherical surface thereon which forms the outer periphery thereof and substantially coincides with the circle of revolution, so that the pair of first sockets and the first coupling member form a relatively rotatable ball and socket joint in the first position of the bifurcated arm assembly. However, the clamping means are operable in the first position of the bifurcated arm assembly to squeeze the pair of arm sections further together relatively crosswise the plane of the line of juncture and to a second position of the bifurcated arm assembly in which the inner peripheral surfaces of the first sockets assume a disposition relatively radially within the circle of revolution, and the first coupling member is sufficiently radially compressible at the outer peripheral surface thereof that between the first and second positions of the bifurcated arm assembly, the inner peripheral surfaces of the first sockets can deform the surface of the first coupling member to interlock the bifurcated arm assembly with the first coupling member and vice versa, at a selected angular orientation of the line of juncture with respect to the one object. Moreover, means are operable to produce a differential in the reaction of the respective pairs of first and second end portions of the arm sections to the further squeezing action of the clamping means so that when squeezed further together into the second position of the bifurcated arm assembly, the pair of arm sections pivots relatively toward one another about the first coupling member to seize the base and rigidly interconnect the bifurcated arm assembly with the base at the selected angular orientation of the line of juncture with respect to the one object. Furthermore, in this additional combination, the clamping means may be releasable, and when the clamping means are released, the pair of arm sections may be reciprocable in relation to one another to a third position of the bifurcated arm assembly in which the pair of arm sections is sufficiently spaced apart about the first locus of the first coupling member that the first coupling member is detachable from the bifurcated arm assembly and vice versa.

At times, the base in this further combination takes the form of a second coupling member which has a substantially smooth part spherical outer peripheral surface thereon, and is also compressible radially thereof at the outer peripheral surface thereof, and the mounting device further comprises means forming a pair of operatively opposing second sockets in the second end portions of the pair of arm sections which have substantially smooth part spherical surfaces at the inner peripheries thereof that are rotatably engageable with the second coupling member at the outer peripheral surface thereof in the respective positions of the bifurcated arm assembly lying between the third and first positions thereof inclusive, and which progressively seize the second coupling member by compressing and deforming the outer peripheral surface thereof to interlock the bifurcated arm assembly with the second coupling member when the pair of arm sections is squeezed together in the direction of the second position of the bifurcated arm assembly from the first position thereof.

Often, the base and the arm sections in this further combination are adapted for rotation of the bifurcated arm assembly about the base and vice versa at the second locus of the base.

In still another combination thereof, my mounting device comprises means for forming a first coupling member on a first of the objects and a base on a second of the objects at spaced first and second loci, respectively, adjacent opposite ends of the line of juncture, and a split arm assembly comprising a pair of relatively rigid arm sections which are adapted to be operatively juxtaposed to one another along the line of juncture between the spaced first and second loci of the first coupling member and the base, and have faces thereon which are operatively opposed to one another across a plane coincident with the line of juncture. Releasable clamping means are operable to reciprocate the pair of arm sections in relation to one another relatively crosswise the plane of the line of juncture to form the split arm assembly into a bifurcated arm assembly which has its apex at the second locus of the base and is engaged about the first coupling member. Means form a pair of operatively opposing first sockets in the faces of the respective arm sections, having substantially smooth part spherical surfaces at the inner peripheries thereof which substantially coincide with a circle of revolution that has its center at the first locus of the first coupling member when the bifurcated arm assembly is engaged in a first position thereof about the first coupling member. Meanwhile, the first coupling member has a substantially smooth part spherical surface thereon which forms the outer periphery thereof and substantially coincides with the circle of revolution, so that the pair of first sockets and the first coupling member form a relatively rotatable ball and socket joint in the first position of the bifurcated arm assembly. However, the clamping means are operable in the first position of the bifurcated arm assembly to reciprocate the pair of arm sections in relation to one another to a second position of the bifurcated arm assembly in which the first sockets assume a disposition relatively radially within the circle of revolution, and the first coupling member is sufficiently radially compressible at the outer peripheral surface thereof that between the first and second positions of the bifurcated arm assembly, the inner peripheral surfaces of the pair of first sockets can deform the surface of the first coupling member to interlock the bifurcated arm assembly with the first coupling member and vice versa. But, the inner peripheral surfaces of the first sockets are also substantially smooth over sufficient acute extent circumferentially of the outer peripheral surface of the first coupling member,

and the first coupling member is sufficiently resilient about the surface thereof, that when the clamping means are released, the pair of first sockets and the first coupling member reform a relatively rotatable ball and socket joint at the first position of the bifurcated arm assembly, so that the bifurcated arm assembly can be rotated about the first coupling member to vary the angular orientation of the line of juncture with respect to the first coupling member.

When the clamping means are released in certain embodiments of this still further combination, the pair of arm sections are reciprocable in relation to one another to a third position of the bifurcated arm assembly in which the faces of the pair of arm sections are sufficiently spaced apart about the first locus of the first coupling member that the first coupling member is detachable from the bifurcated arm assembly and vice versa. Moreover, in some of these embodiments, the base takes the form of a second coupling member which has a substantially smooth part spherical surface thereon that forms the outer periphery thereof, and which is also compressible radially thereof at the outer peripheral surface thereof, and the mounting device further comprises means forming a pair of operatively opposing second sockets in the faces of the respective arm sections which have substantially smooth part spherical surfaces at the inner peripheries thereof that are rotatably engageable with the second coupling member at the outer peripheral surface thereof in the respective positions of the bifurcated arm assembly lying between the third and first positions thereof inclusive, and which progressively seize the second coupling member by compressing and deforming the surface thereof to interlock the bifurcated arm assembly with the second coupling member when the pair of arm sections is reciprocated in relation to one another in the direction of the second position of the bifurcated arm assembly from the first position thereof.

The releasable clamping means in these latter embodiments may include yieldable biasing means operable to space the pair of arm sections from one another at the faces thereof relatively crosswise the plane of the line of juncture, and a releasable clamping mechanism operable against the bias of the yieldable biasing means to reciprocate the pair of arm sections relatively toward one another at the faces of the arm sections, the yieldable biasing means and the clamping mechanism being engaged with the pair of arm sections in the space between the first and second loci of the first coupling member and the base, respectively, to form the split arm assembly into a bifurcated arm assembly which has its apex at the second locus of the base when the pair of arm sections is reciprocated relatively toward one another at the faces thereof. Furthermore, in certain embodiments, the faces of the respective arm sections may have recesses therein between the first and second loci of the first coupling member and the base, and the yieldable biasing means may take the form of a coiled spring which is caged between the respective arm sections at the recesses in the faces thereof.

Sometimes, the space between the first and second loci of the first and second coupling members is of such length that when the first coupling member is detached from the bifurcated arm assembly and vice versa, the arm sections can be pinched together against the bias of the spring to separate the pair of second sockets from one another to the extent that the second coupling member can be detached from the pair of arm sections and vice versa.

At times, moreover, the arm sections may have a pair of mutually opposing openings therein at the bottoms of the recesses, and the clamping mechanism may take the form of an elongated bolt which is passed through the pair of

openings and has a flange on one end portion thereof and threading on the other end portion thereof, and a knob which is threadedly engaged with the threading on the other end portion of the bolt and cooperable with the flange on the bolt to clamp the pair of arm sections therebetween.

In a still further combination thereof, the first coupling member of the device has a reduced diameter neck at a side thereof opposed to the part spherical surface thereof, and the first sockets have rims formed thereabout at the faces of the respective arm sections, and indentations in the respective rims thereof at the plane of the line of juncture, which together are greater in width than the neck so that the bifurcated arm assembly can be rotated about the first locus of the first coupling member to angular orientations in which the line of juncture extends at right angles to the neck of the first coupling member. Where the respective arm sections have ends adjacent the first sockets, the first sockets may also have indentations in the respective rims thereof at the adjacent ends of the arm sections, which together are greater in width than the neck so the bifurcated arm assembly can be rotated about the first locus of the first coupling member to angular orientations in which the plane of the line of juncture extends at oblique angles to the first coupling member.

In yet another combination, the first sockets have rims formed thereabout at the faces of the respective arm sections and the first sockets have cruciate grooves at the inner peripheries thereof subdividing the part spherical surfaces thereof into four relatively smaller part spherical surfaces apiece, each of which terminates at the groove in the respective first socket and the rim thereabout.

BRIEF DESCRIPTION OF THE DRAWINGS

These features will be better understood by reference to the accompanying drawings wherein I have illustrated a presently preferred embodiment of my mounting device wherein the split arm assembly is interposed between a pair of couplers on a medical monitor and a relatively stationary surface therebelow, and clamped about a pair of ball-shaped coupling heads on the couplers to support the monitor on the surface at various angular orientations thereto.

In the Drawings:

FIG. 1 is a perspective view of the monitor, surface and mounting device when the split arm assembly has been clamped about the heads of the couplers to form a connection therebetween and then clamped about them further to rigidify the connection and thereby support the monitor on the surface;

FIG. 2 is a perspective view of the mounting device alone after it has been exploded into the respective components thereof to aid in understanding the combination of them;

FIG. 3 is a plan view of the relatively inside face of one end portion of one arm section split arm assembly in the device;

FIG. 4 is a cross sectional view along the line 4—4 of FIG. 1 when the split arm assembly of the device has been clamped about the heads of the couplers to form a ball and socket joint at the head of one of the couplers, but not squeezed about the heads to the extent that the connection formed between the heads by the device is rigidified;

FIG. 5 is a part cross sectional view along the line 5—5 of FIG. 4 illustrating the effect on the ball and socket joint formed about the head of the one coupler when the split arm assembly has been squeezed further together about the heads of the respective couplers to rigidify the connection therebetween;

FIG. 6 is a perspective view of an alternative form of coupler which is mountable on an object to be coupled by inserting it in a hollow shoe secured to the object in question;

5 FIG. 7 is a plan view of the shoe at the bottom thereof, when the alternative form of coupler has been inserted in the hollow of the shoe and the bottom of the shoe itself has been removed to show how the coupler engages therein; and

10 FIG. 8 is a perspective view of a lighting assembly wherein a pair of the mounting devices is employed in mounting a pair of lamps on a clamping device which is adapted to be mounted in turn on a support (not shown) extending relatively crosswise thereof.

15 BEST MODE FOR CARRYING OUT THE INVENTION

Referring initially to FIGS. 1-5, it will be seen that the medical monitor 12 is supported in an upright U-shaped
20 bracket 6 secured to the same by a fastener 7, and the bracket and monitor are supported in turn on a mounting device 10 of my invention which is mounted upright in turn on a relatively stationary surface 14 therebelow. The mounting device 10 comprises a split arm assembly 1, a device 20 with
25 which to fasten together the pair of elongated, relatively rigid arm sections 16 and 18 in the assembly, a coiled spring 44 (FIG. 2) with which to separate the pair of arm sections when they are fastened together, a clamping mechanism 2 with which to squeeze together the pair of arm sections
30 against the yieldable bias of the spring, and a pair of couplers 100 and 102 with part spherical heads 22 and 24 thereon, respectively, to which the split arm assembly 1 is clamped by the clamping mechanism 2 when the device 10 is put to use in mounting the bracket 6 and monitor 12 on the surface
35 14. The respective arm sections 16 and 18 are identical, and are arranged in the mounting device 10 so as to be operatively juxtaposed to one another along a line of juncture 13 (FIG. 2) extending therebetween. In that disposition, the respective arm sections have faces 15 thereon which are
40 operatively opposed to one another across a plane 5 (FIG. 4) coincident with the line of juncture 13; and also pairs of corresponding first and second end portions 3 and 4 thereof that are operatively opposed to one another across the same plane. There are pairs of recesses in the faces of the
45 respective arm sections, forming pairs of operatively opposing first and second sockets 25 and 26 in the pairs of first and second end portions 3 and 4 of the arm sections, respectively; and the respective pairs of sockets 25 and 26 have part spherical surfaces at the inner peripheries thereof, and
50 rims 98 formed thereabout on the faces 15 of the respective arm sections. The respective rims 98 have indentations 99 formed therein at the plane 5 of the line of juncture, and additional indentations 101 formed therein at the adjacent ends of the arm sections. Moreover, the respective pairs of
55 sockets have cruciate grooves 27 formed therein at the inner peripheries thereof, and the respective grooves subdivide the part spherical surfaces of the respective sockets into four relatively smaller part spherical surfaces apiece, each of which terminates at the groove 27 in the respective socket
60 and at the rim 98 formed thereabout.

At the midsections of the arm sections 16 and 18, the faces 15 of the respective arm sections have reduced diameter
waists 103 (FIG. 3), and additional recesses 28 (FIG. 3) formed therein, which are elongated lengthwise of the
65 respective arm sections, and are relieved still deeper at the opposite ends thereof to form pairs of sumps 32 (FIG. 3) in the end portions of the respective arm sections, which have

rounded bosses 30 upstanding therein. Between the pairs of
sumps, the recesses 28 also have part circular lands 104
formed on the bottoms thereof, which in turn have cylin-
drical openings 29 therein. At their outsides, the openings 29
are surrounded by circular lands 106 (FIG. 2) having coun-
terbores 108 therein at the mouths of the openings 29. When
the pair of arm sections 16 and 18 is operatively juxtaposed
to one another to form the split arm assembly 1, the openings
29 are disposed to assume a substantially coaxial relation-
ship with one another and the spring 44 is interposed
between the pair of opposing sumps 32 in the end portions
4 of the arm sections, and circumposed about the bosses 30
on the pair of sumps, so as to be caged lengthwise between
the pair of end portions 4 when the pair of arm sections is
squeezed together by the clamping mechanism 2. In that
disposition, the spring yieldably bias the pair of arm sections
to relatively separate from one another when the clamping
mechanism is relaxed, but is compressed between the pair of
arm sections when the arm sections are squeezed together by
the clamping mechanism.

Meanwhile, the fastening device 20 is interconnected
between the pair of arm sections along the axis 109 of the
openings 29, where it can also be subjected to compression
by the clamping mechanism 2. The fastening device 20
comprises an elongated bolt 110 with a hexagonal head 8 at
one end of the elongated shank 38 thereof, and threading on
the opposing end portion 112 of the shank. It also comprises
an internally threaded knob 40 with diametrically opposing
wings 114 thereon, and a washer 42 that is to be sleeved
about the shank 38 of the bolt ahead of the knob 40. The
internal threading of the knob 40 is sized to threadedly
engage with the threaded end portion 112 of the shank, and
the pair of arm sections 16 and 18 is fastened together by
passing the shank of the bolt 110, first, through the opening
29 in the arm section 16 and then through the opening 29 in
the arm section 18, then sleeving the washer 42 about the
projecting threaded end portion 112 of the shank of the bolt,
and then threadedly engaging the knob 40 on the threaded
end portion 112 of the shank of the bolt while the head 8 of
the bolt is engaged in the counterbore 108 of the opening 29
in the arm section 16.

In the arrangement, the knob 40 and the bolt 110 also
function as the clamping mechanism 2, in that the pair of
arm sections can be squeezed together along the longitudinal
axis 109 of the bolt 110, and against the bias of the spring
44, by threading the knob 40 relatively inwardly along the
length of the threaded end portion 112 of the shank of the
bolt in the direction of the head 8 thereof. Alternatively, the
pair of arm sections can be allowed to retract from one
another by unthreading the knob 40 along the shank 38 of
the bolt in the opposite direction, to allow the bias of the
spring 44 to separate the pair of arm sections from one
another. Meanwhile, in both cases, because of the eccen-
tricity of the spring 44 with respect to the axis 109 of the bolt
110, there is a differential in the reaction of the respective
pairs of first and second end portions 3 and 4 of the arm
sections to the clamping forces generated by the clamping
mechanism 2, and this differential has a major role in the
operation of the mounting device 10, as shall be explained.

The couplers 100 and 102 are identical and each comprise
a disc-shaped base 47 and 48, respectively, with a reduced
diameter neck 46 relatively upstanding thereon, and a ball
shaped head 22 and 24, respectively, upstanding in turn on
the neck. The head has part spherical surfaces 41 (FIG. 5)
about the outer periphery thereof, and a pressure deformable
elastomeric material in the body thereof, which renders the
head relatively radially compressible between the respective

part spherical surfaces 41 thereof. The material is also relatively resilient, however, so that when the compressive forces are released, the body of the head will resume its original ball shaped configuration at the surfaces 41 thereof.

5 The respective heads 22, 24 are sized so that the radii thereof are approximately equal to those of the inner peripheral surfaces of the sockets 25 and 26, and in the operation of the device 10, the sockets 25 in the end portions 3 of the arm sections 16, 18, are engaged about the head 22 of the coupler 100 so as to form a ball and socket joint 43 (FIG. 4) 10 therebetween. That is, the inner peripheral surfaces of the sockets 25 and the part spherical surfaces 41 of the head 22 are caused to substantially coincide with a first circle of revolution 37 (FIG. 5) having its center at the first locus 21 15 of the head. Later in the operation of the device, the inner peripheral surfaces of the sockets 26 in the end portions 4 of the arm sections 16, 18 are caused to engage about the surfaces 41 of the head 24 of the coupler 102 to form a similar joint therebetween, but only that between the head 22 and the sockets 25 is shown in the drawings. In each case, 20 the pressure deformable material in the body of the head enables the head to be squeezed between the surfaces 41 thereof to less than the diameter of the circle of revolution 37 with which the respective surfaces of the sockets and the head coincide. Moreover, the resiliency of the material in the body of the head enables the surfaces 41 thereof to resume coincidence with that circle when the compression on the head is released in a subsequent stage in the operation of the device.

30 The base of each coupler has openings 116 therein for screws 118 with which the coupler is fastened to an object to be coupled. In FIG. 1, for example, the coupler 100 is fastened in this manner to the underside of the bracket 6, whereas the coupler 102 is fastened in like manner to the mounting surface 14.

35 When the mounting device 10 is put to use, there are two principal stages in the operation of it, a first stage in which the split arm assembly and the clamping mechanism are employed to make a loose connection between the pair of 40 objects 6 and 14, and a second stage in which that connection is rigidified so as to support one object 6 on the other 14. Meanwhile, between the two stages, there is an intermediate stage in which the angular orientation of the line of juncture 13 between the pair of arm sections 16 and 18 can 45 be varied with respect to either or both of the objects, so as to vary the angular orientation of one object, 6, with respect to the other 14. This is true whether the device 10 has been put through the first stage in the operation thereof, but not the second, or has been put through both stages of its 50 operation, and then the second or rigidification stage has been reversed, so as to derigidify the connection and enable the angular orientation of the line of juncture 13 to be varied once again. It is also true that whether the adjustment is made before the rigidification stage, or at the end of the 55 derigidification stage, the device 10 will persist in maintaining a connection between the pair of objects while the adjustment is made. The connection can be made to have sufficient rigidity at one end thereof, 3, 100, 3, moreover, that the adjustment can be made at the other end thereof, 4, 60 102, 4 while the rigidity of the one end 3, 100, 3 is relied on to maintain the angular orientation of the line of juncture 13 with respect to the object 6 at the one end of the connection.

In carrying out the two stages of operation, two different portions 112' and 112" of the threading 112 on the shank 38 65 of the bolt 110 are employed in applying the clamping forces to the pair of arm sections. Moreover, in carrying out the two stages, the end portions 3 and 4 of the pair of arm sections

13

undergo two different phases in the reaction thereof to the clamping forces. Both effects will become apparent in the explanation of the operation of the device 10 which follows.

To carry out the operation, initially, the two couplers 100 and 102 are secured to the pair of objects 4 and 14, 5 respectively, to form a first coupling member 22 on a first, 6, of the objects, and a base 48 on the second, 14, of the objects. The couplers and objects are also arranged so that the first coupling member 22 and the base 48 are spaced apart from one another at first and second loci 21 and 23, 10 respectively, adjacent the opposite ends of a line of juncture 13 along which the mounting device 10 is to be interposed between the pair of objects. This leaves part spherical surfaces 41 of the first coupling member 22 disposed on opposite sides of a plane 5 (FIG. 4) of the line of juncture, 15 and substantially in coincidence with a first circle of revolution 37 (FIG. 5) having its center at the first locus 21 of the first coupling member 22. Either simultaneously with or subsequent to securing the couplers to the pair of objects, the split arm assembly 1 is arranged about the line of juncture 20 so that the pair of arm sections 16 and 18 is operatively juxtaposed to one another along the line between the spaced first and second loci 21 and 23 of the first coupling member and the base, and the pairs of corresponding first and second end portions 3 and 4 of the arm sections are operatively 25 opposed to one another across the aforementioned plane 5 of the line of juncture. The faces 15 of the arm sections are likewise operatively opposed to one another across the plane 5 of the line of juncture. Meanwhile, the spring 44 and the fastening device 20 are engaged between the split arm 30 assembly 1 so as to hold the pair of arm sections together, and the knob 40 is threaded onto the tip end portion 112' of the threaded end portion 112 of the shank of the bolt and rotated sufficiently inwardly about the threading on the tip end portion 112' to apply initial clamping forces to the pair 35 of arm sections and thereby squeeze the pair of arm sections together relatively crosswise the plane 5 of the line of juncture. As the pair of arm sections is squeezed together, however, the spring 44 produces a differential in the reaction of the respective pairs of first and second end portions 3 and 40 of the arm sections, so that the pair of arm sections assumes a relatively transversely contracted disposition thereof about the first coupling member 22 and the base 48 in which the pair of first sockets 25 in the pair of first end portions 3 of the arm sections is operatively engaged about 45 the peripheral surfaces 41 of the first coupling member 22 in substantial coincidence with the first circle of revolution 37, but the pair of second end portions 4 of the arm sections is spaced apart from one another about the base 48 to the extent that although the pair of arm sections forms a connection 50 between the first coupling member and the base, at the second coupling member or attachment means provided by the head 24, the connection allows the pair of arm sections to be squeezed further together about the base 48. This completes the first stage in the operation of the device and 55 inasmuch as at the conclusion of it, the pair of first sockets 25 forms a first ball and socket joint 43 (FIG. 4) with the outer peripheral surfaces 41 of the first coupling member 22, the first coupling member and the pair of arm sections can be pivoted in relation to one another at the first joint 43 60 to position the line of juncture 13 at any angular orientation desired with respect to either or both of the objects 6, 14. Meanwhile, the first coupling member and the base will remain connected by the device. However, because of the differential in the reaction of the pairs of end portions 3 and 65 of the arm sections, the connection can be made tighter at the end thereof comprising the head 22, and an adjustment

14

can be made more readily at the end of the connection comprising the second coupling member or head 24. An adjustment can be made at either end, however, and while it is being made, the connection will continue to remain intact, so that only limited assistance from an operator is needed to support one object on the other during this intermediate stage.

When an angular orientation for the line of juncture 13 has been selected, the device 10 can be put through the second stage in the operation thereof to rigidify the connection between the pair of objects. In this instance, the knob 40 is rotated about the next successive longitudinal portion 112" of the threading on the shank 38 of the bolt 110 to apply additional clamping forces to the pair of arm sections, and to apply those forces to the extent necessary to rigidify the connection between the first coupling member 22 and the base 48 at the selected angular orientation of the line of juncture 13 with respect to the pair of objects 6, 14. During the first stage in the operation of the device, the end portions 3, 4 of the pair of arm sections underwent a "free-swinging" first phase in the reaction thereof to the clamping forces because the compressed length of the spring 44 remained greater than the diameters of the heads 22 and 24. During the second stage in the operation of the device, the end portions 3, 4 will continue to undergo a "free-swinging" phase, but only so long as the compressed length of the spring is greater than the diameter of the heads 22 and 24. When the compressed length of the spring is equal to the diameter of the heads, that is, when the clamping mechanism 2 has completely overcome the relatively transversely outwardly directed forces of the spring, then the end portions 3, 4 will enter a second phase in the reaction thereof to the clamping forces of the mechanism 2, and this second phase is possible only because the first coupling member 22 is not hard and incompressible. This is to say, were the first coupling member hard and incompressible, the clamping mechanism would no longer be able to leverage the arm sections 16, 18 into engagement with the head 24 of the coupler 102, because of the equilibrium established between the heads 40 and the spring. Likewise, the spring would no longer be able to produce a differential in the reaction of the end portions 3, 4 to the clamping forces of the mechanism 2. In short, the mechanism would be rendered ineffective to produce any further useful result, other than perhaps to increase the friction between the pair of sockets 25 and the first coupling member 22. But that is not the case with the present mounting device 10. To the contrary, when the compressed length of the spring is equal to the diameter of the heads 22, 24, the compressibility of the head 22 enables the clamping mechanism 2 to continue leveraging the arm sections 16, 18 into engagement with the head 24 of the coupler 102, and the spring in turn to continue producing a differential in the reaction of the end portions 3, 4 of the arm sections to the clamping forces of the mechanism. Moreover, the body of the first coupling member 22 also has resiliency in the material thereof, so that with each increment of reduced diameter in the body of the member, a greater proportion of the clamping forces is applied to the end portions 4 of the arm sections to produce a pliers-like grip on the head 24 of the coupler 102 at the sockets 26. That is, the bifurcated arm assembly formed by the clamping mechanism 2 from the split arm assembly 1, and having its apex at the locus 21 of the first coupling member 22, is reciprocated from the "first" position thereof in which a ball and socket joint 43 was formed between the first coupling member 22 and the sockets 25, to a "second" position thereof in which the head 24 of the coupler 102 is sufficiently compressed to interlock

the bifurcated arm assembly with the head and vice versa. Meanwhile, even as the pair of arm sections is pivoting about the first coupling member 22 to reduce the space between the end portions 4 of the arm sections about the base 48 of the coupler 102, the pair of sockets 25 is engaging the surfaces 41 on the body of the first coupling member to squeeze the body of the first coupling member therebetween and interlock the pair of arm sections with the first coupling member to rigidify the connection between the first coupling member and the base 48 of the coupler 102 at the selected angular orientation of the line of juncture 13 with respect to the pair of objects 6, 14. See FIG. 5 wherein the inner peripheral surfaces of the pair of first sockets 25 are embedded in the surfaces 41 of the first coupling member to a second circle of revolution 45 having its center at the locus 21 of the first coupling member but smaller in diameter than the first circle of revolution 37.

Furthermore, because of the inherent resiliency in the body of the first coupling member 22, the first joint 43 can be restored if desired, to enable a further adjustment to be made in the orientation of the line of juncture, by releasing the clamping mechanism 2 relatively crosswise the plane 5 of the line of juncture until the pair of arm sections and the first coupling member can be pivoted in relation to one another to a new location at which the line of juncture is repositioned at a different angular orientation with respect to the pair of objects 6, 14.

Alternatively, while the clamping mechanism is being released, the pair of arm sections can be retracted in relation to one another to a "third" position of the bifurcated arm assembly in which the faces 15 of the pair of arm sections are sufficiently spaced apart from one another about the head 24 of the coupler 102, that the head 24 is detachable from the bifurcated arm assembly and vice versa. In addition, the space between the first and second loci 21, 23 of the pair of couplers 100, 102 may be of such length, due to the length of the split arm assembly itself, that when the head 24 is detached from the bifurcated arm assembly and vice versa, the end portions 4 of the arm sections can be pinched together against the bias of the spring 44 to separate the pair of sockets 25 from one another to the extent that the first coupling member 22 can also be detached from the pair of arm sections and vice versa.

When operatively opposed to one another, the indentations 99 formed in the rims 98 of the sockets 25, 26 form slots therebetween that are greater in width than the necks 46 of the couplers, so that the angular orientation of the line of juncture 13 can be made to extend at right angles to the neck of either coupler, if desired, for example, by rotating the bifurcated arm assembly about the head of that coupler until the neck of the coupler engages in the slot formed by the indentations. Similarly, the indentations 101 formed in the rims 98 of the sockets at the ends of the arm sections form "fish mouths" therebetween that are sufficiently wider than the necks of the couplers, that the bifurcated arm assembly can be rotated about a head, for example, the head 22 of the coupler 100, to an angular orientation in which the plane 5 of the line of juncture 13 extends at an oblique angle to the head.

The indentations 99 and 101 and the cruciate grooves 27 in the sockets 25, 26 also provide recesses into which the bodies of the respective heads 22, 24 can deform when they are subjected to compression by the pairs of sockets 25, 26 corresponding thereto.

Commonly the respective heads 22, 24 are formed of nitrile rubber material at the surfaces 41 thereof. Other

materials, including other hardened rubber and elastomer materials, may be employed. The materials are commonly given a Shore A durometer of between about 30–100 and preferably between about 60–100. Most preferable is a Shore A durometer of about between 85–90. In some versions, the heads have a Shore D hardness of between 40 and 70.

While supporting one object on another, the mounting device 10 will also operate to damp the transmission of mechanical vibrations from one object to the other, and in fact to function as a shock absorber between the two. Furthermore, the heads 22, 24 will act as electrically insulative media in the combination, so that any stray current on one object will not travel to the other.

When the clamping mechanism 2 has been released sufficiently to detach the split arm assembly from the coupler 102 and vice versa, the remainder 100, 1 of the device 10 can be moved in conjunction with the object 6 to a new location, and attached to a different coupler 102 at that location. Alternatively, the device 10 can be detached from both objects 6, 14, and moved from one location to another separate from both objects, if desired.

An alternative coupler 50 is seen in FIGS. 6 and 7. The alternative coupler 50 has a base 54, a neck 56 upstanding on the base, and a resiliently compressible head 52 on the neck, as in the embodiment of FIGS. 1–5. But the base 54 takes the form of a generally rectangularly shaped plate which is slidably insertable in a hollow shoe 58 for the base having a keyhole-shaped slot 119 in the top 62 thereof. The shoe has a rectangular bottom 60 that is securable to an object, and a similarly shaped top 62 thereon forming a shallow hollow 120 therebetween, which opens to the exterior of the shoe through the slot 119. The top of the shoe also has a pin 121 depending therefrom in the hollow of the shoe, and about which a latch 64 is pivotally mounted. The latch 64 has an arm 72 on one end thereof, which projects through a slot 122 in one side of the top of the shoe, and a hook 66 on the opposite end thereof which is engageable in a recess 70 in one side of the plate-like base 54 of the coupler 50. A spring 124 biases the hook 66 of the latch 64 into engagement with that side of the base 54 of the coupler when the base is inserted in the hollow 120 of the shoe 58 at the slot 119 thereof. When the neck 56 and head 52 of the coupler are upstanding in the center opening 125 of the slot 119, the hook 66 engages in the recess 70 to retain the coupler 50 in the shoe until the lever 72 is actuated to disengage the hook 66 from the recess 70 and enable the coupler to be removed from the shoe. When desired, a number of such shoes 58 can be secured to a workbench, ceiling, wall or the like, at various locations thereon, so that a mounting device 10 can be employed at any one of the locations and then shifted to another location when desired. Alternatively, a plurality of couplers 50 can be secured to an equal number of lights, instruments, sensors or the like, and then a selected light, instrument or sensor can be coupled to a mounting device 10 at a particular site, by inserting the base 54 of the coupler secured to the same, into a shoe 58 at that site.

FIG. 8 illustrates how a pair of mounting devices 10 can be equipped with a pair of lamps 86 and secured to an intermediate coupling device 82 that is clampable in turn to an elongated support (not shown), such as a stanchion, by way of collectively mounting the pair of lamps on the support. In FIG. 8, the coupling device 82 comprises a pair of jaws 88 and 90 that are pivotally secured to one another by a fastener (not shown) extending through coaxial openings (not shown) in the rear end portions 126 thereof, and that are sized to engage one within the other at the forward